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(54) **MICROMECHANICAL COMPONENT AND METHOD FOR PRODUCING A MICROMECHANICAL COMPONENT**

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B81B 7/02 (2006.01)
B81C 3/00 (2006.01)

(52) **U.S. Cl.**

CPC ***G02B 26/085*** (2013.01); ***B81B 7/02*** (2013.01); ***B81C 3/008*** (2013.01); *Y10T 29/49826* (2015.01)

(58) **Field of Classification Search**

CPC G02B 26/085; G02B 26/0833
USPC 359/221.2, 291, 200.7, 212.1, 213.1, 359/223.1, 224.1
See application file for complete search history.

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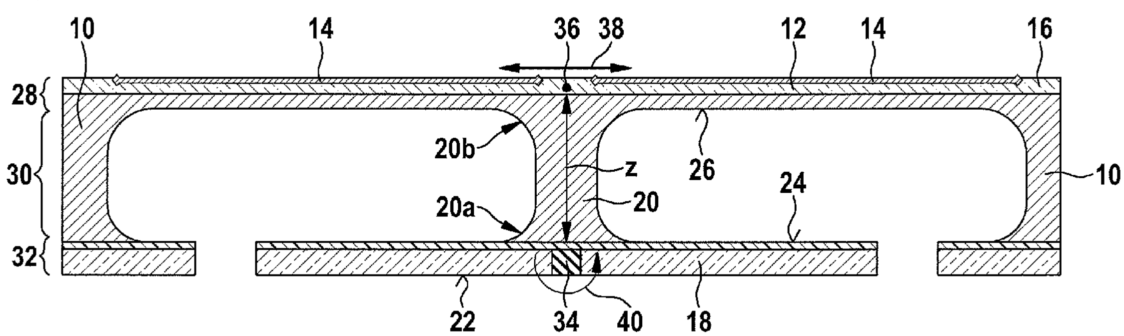
(57) **ABSTRACT**

A micromechanical component is described as having a mounting support, an actuator plate having a coil, situated on and/or in the actuator plate, which is connected to the mounting support via at least one supply line spring. A mirror element and/or filter element is connected to the mounting support via the actuator plate and the at least one supply line spring. A spacer has a first end that contacts an inner side of the mirror element and/or the filter element that is directed away from an incident light surface of the mirror element and/or the filter element. The spacer has a second end that contacts a carrier side of the actuator plate that is aligned towards the mirror element and/or the filter element. Also described is a method for producing a micromechanical component.

15 Claims, 4 Drawing Sheets



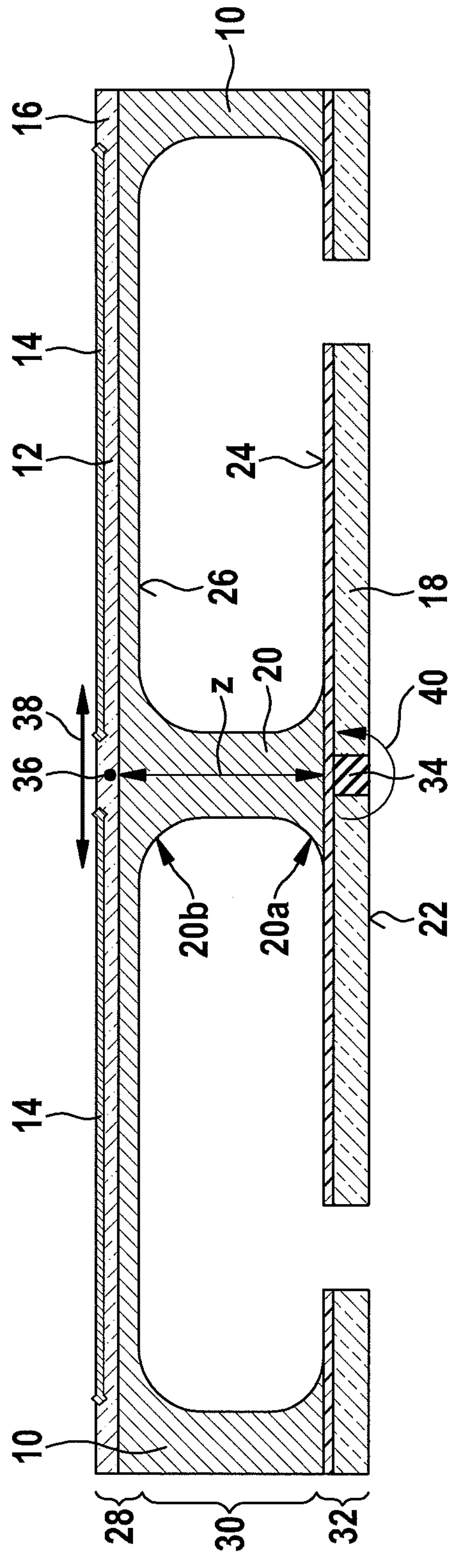
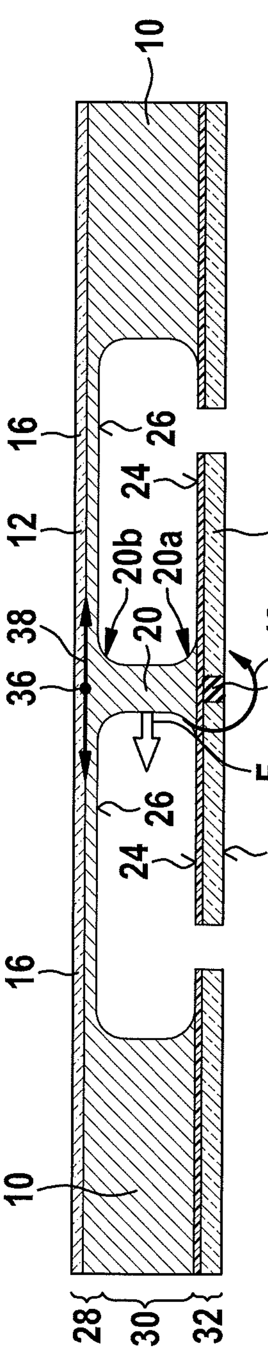


Fig. 1


10
16
26
24
12
20b
20a
18
38
20
40
36
34
F
26
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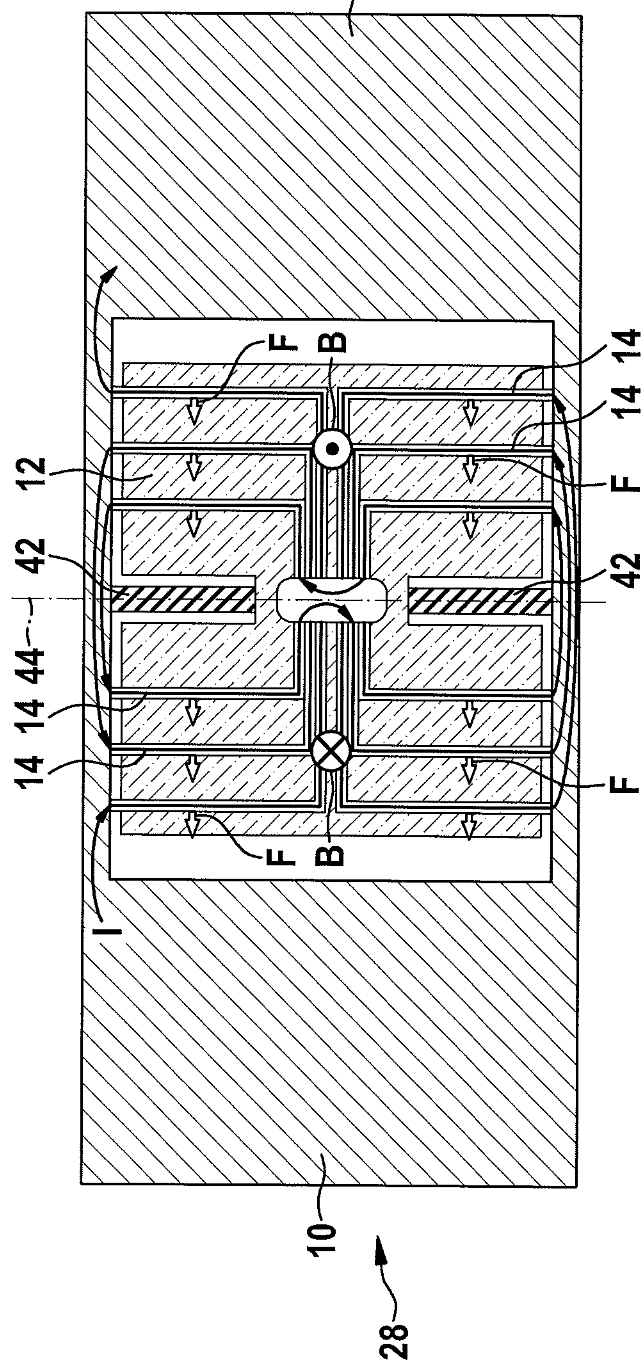
30
32

Fig. 2a


10
F
B
14
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14
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42
42
44
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14
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B
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10
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Fig. 2b

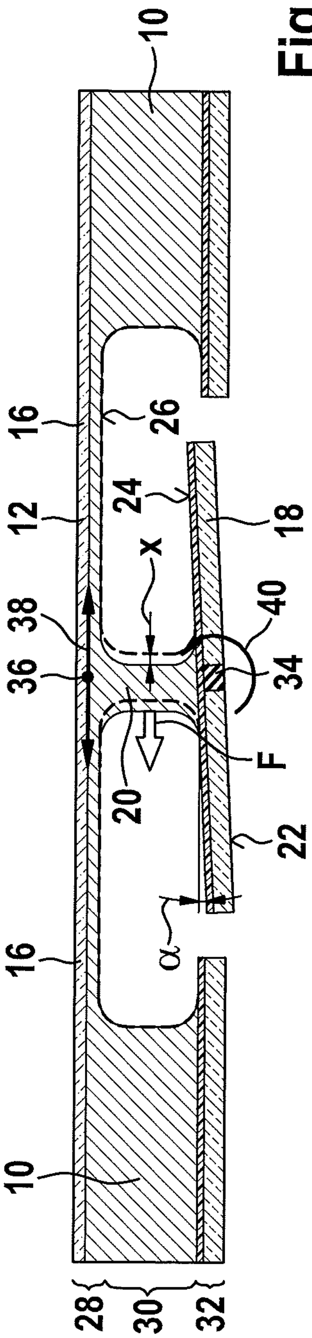

Fig. 2c

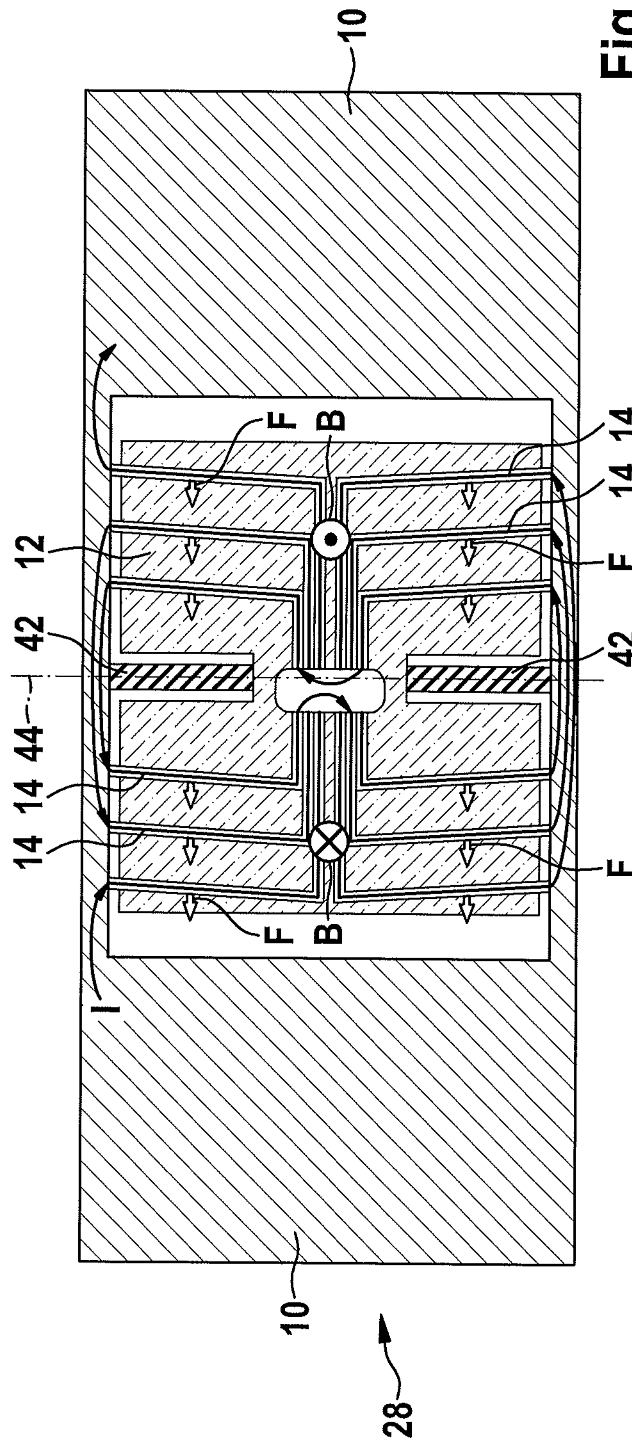

Fig. 2d

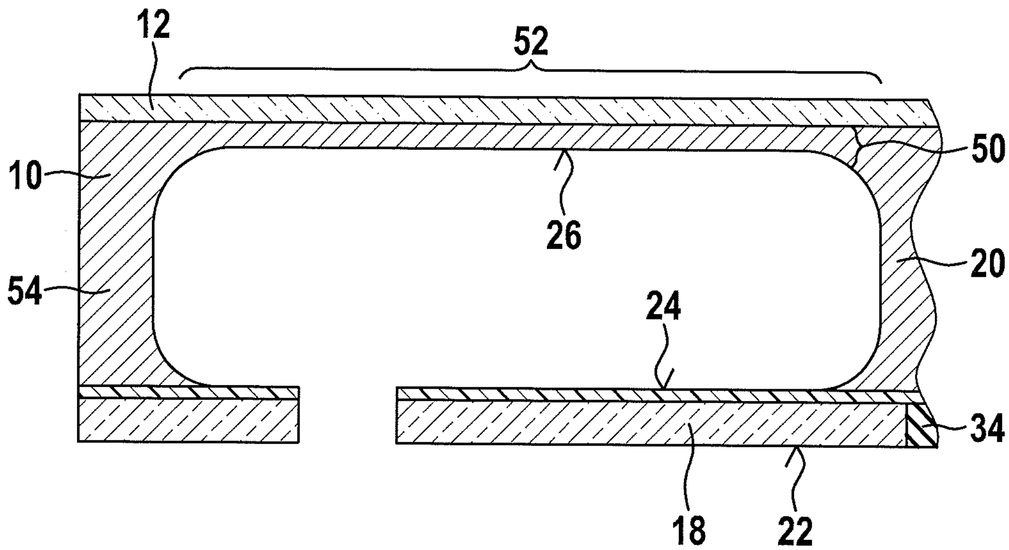

Fig. 3

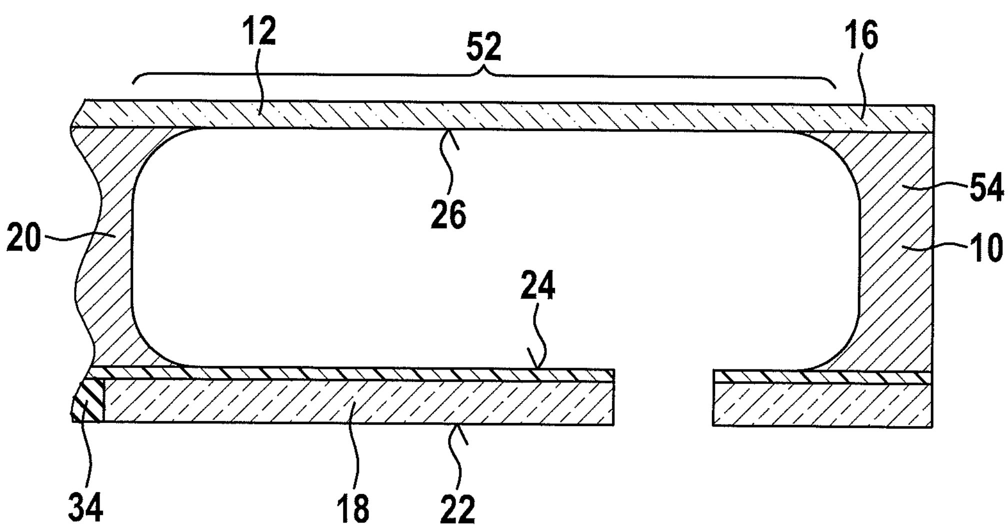

Fig. 4

MICROMECHANICAL COMPONENT AND METHOD FOR PRODUCING A MICROMECHANICAL COMPONENT

FIELD OF THE INVENTION

The present invention relates to a micromechanical component and a micromirror device. The present invention also relates to a method for producing a micromechanical component. In addition, the present invention relates to a method for producing a micromirror device.

BACKGROUND INFORMATION

European Published Patent Application No. 0 838 285 describes an electromagnetic actuator developed on a mirror device. The mirror device includes an outer actuator plate that is framed by a mounting support and an inner actuator plate that is framed by the outer actuator plate, which are each connected via two supply line springs to the skirting unit. Coils are developed on the actuator plates which are able to be supplied with current in such a way that the respective actuator plate is able to be adjusted with reference to the surrounding unit, based on a Lorenz force, about a respective rotational axis. In this way, a mirror situated on the inner actuator plate is supposed to be adjustable about two axes of rotation.

SUMMARY

The present invention implements a micromechanical component, whose mirror element and/or filter element are able to be situated in a first plane, which lies outside a second plane of the actuator plate. This may also be paraphrased to say that the coil that is usable for an electromagnetic drive and requires a relatively large attachment area is able to be accommodated below or above the mirror element and/or the filter element developed as a mirror plate or filter. In this way, the expansion of the micromechanical component parallel to an incident light surface of the mirror element and/or filter element is able to be significantly reduced. The reduction of the expansion of the micromechanical component parallel to the incident light surface of the mirror element and/or filter element simplifies its arrangement at a preferred position. In addition, the reduction of the expansion of the micromechanical component in parallel to the incident light surface is able to contribute to its cost reduction.

In addition, the present invention implements a micromechanical component having a mechanical lever for optimizing the force able to be exerted/disposable for adjusting the mirror element and/or filter element, and/or for increasing an achievable excursion of the mirror element and/or filter element with reference to the mounting support. Using the implementable lever system of the mirror system and/or filter system, the drive efficiency is able to be increased in response to adjusting the mirror element and/or filter element. Consequently, the mirror element and/or filter element is able to be adjusted using a simple and cost-effectively executable electromagnetic drive reliably and over a comparatively long adjustment path.

The carrier side of the actuator plate is aligned, for example, in parallel to the incident light surface and/or the inner side of the mirror element and/or filter element, at least while no current is supplied to the coil. This makes possible an especially space-saving arrangement of the actuator plate with the coil in the micromechanical component.

At least one line is preferably guided via at least one supply line spring in such a way that the coil is able to be supplied with current. Consequently, the supply line spring is able to be utilized for connecting the coil to an electronic system of an electromagnetic drive that is developed on or in the mounting support.

The at least one supply line spring is able to be formed exclusively of at least one conductive material, which spans at least one gap lying between the actuator plate and the mounting support in a self-supporting manner. Consequently, the at least one supply line spring is easily able to be developed having a comparatively low supply line spring constant. At the same time, the at least one supply line spring is able to be utilized as at least one line for supplying current to the coil.

As an alternative or as a supplementation to this, the at least one supply line spring may be developed to be meander-shaped and/or spiral-shaped. The supply line spring constant may also be significantly reduced by a meander-shaped and/or a spiral-shaped development of the at least one supply line spring.

In one advantageous refinement, the mirror element and/or filter element is additionally connected to the mounting support via at least one vibratory spring which spans at least one further gap lying between the mirror unit and/or filter unit and the mounting support. The at least one vibratory spring may be utilized to increase the stiffness of the overall spring system made up of the at least one supply line spring and the at least one vibratory spring, via which the mirror element and/or filter element is connected to the mounting support. In this way, a natural frequency of a desired excursion motion/adjustment motion of the mirror element and/or filter element is able to be set to a preferred value for deflecting a light beam directed upon it. In addition, using a suitable development/guidance of the at least one vibratory spring, the alignment of the preferred vibratory motion of the mirror element and/or filter element is able to be steered in the desired direction.

The at least one vibratory spring is advantageously developed as a torsional spring. As will be discussed more exactly below, there is thus able to be implement reliably an advantageous mechanical lever for optimizing an adjusting force exerted upon a mirror element and/or filter element.

The mirror element and/or filter element is preferably able to be set into an adjusting motion by supplying current to the coil and providing a magnetic field at the coil, which is counteracted by a supply line constant of the at least one supply line spring and a vibratory spring constant of the at least one vibratory spring, the supply line spring constant of the at least one supply line spring being less than the vibratory spring constant of the at least one vibratory spring. Because of the development of the at least one supply line spring having a smaller supply line spring constant than the vibratory spring constant of the at least one vibratory spring, a mechanical stress occurring in response to the excursion of the mirror element and/or filter element with respect to the mounting support is able to be reduced in the at least one supply line spring. It may thus be prevented that the at least one line guided via the at least one supply line spring is damaged/deformed during an adjusting motion of the mirror element and/or filter element. Because of the advantageous embodiment of the at least one supply line spring having a comparatively small supply line spring constant, the service life/utilization time of the at least one line for supplying current to the coil is able to be prolonged.

The at least one vibratory spring is advantageously developed as a lineless spring. By this one may understand that no line is guided via the at least one vibratory spring. Consequently, the at least one vibratory spring is able to be developed having a comparatively large vibratory spring constant, without fear of damage of a line, guided via it, based on mechanical stresses occurring in the at least one vibratory spring during the readjusting motion of the mirror element and/or filter element.

In addition, the at least one supply line spring is patterned out of a first layer having a first layer thickness, the at least one vibratory spring being patterned out of a second layer having a second layer thickness that is greater than the first layer thickness. In this way, the advantageous ratio of the supply line spring constant and the vibratory spring constant, in which the supply line spring constant is less than the vibratory spring constant, is able to be effected by a production method that is simple to carry out.

The actuator plate is, for instance, formed from the coil embedded in at least one insulating material, and is suspended in a self-supporting manner using at least two supply line springs in a recess of the mounting support. Thus, the actuator plate is able to be formed having a comparatively low weight. As an alternative to the development of the actuator plate described here, the coil embedded in the at least one insulating material may also be applied onto a semiconductor layer, such as a silicon layer.

The advantages mentioned above may also be assured using a micromirror device having an appropriate micromechanical component.

In one advantageous refinement, the micromirror device additionally includes a further mirror element that is able to be adjusted about a first rotational axis, by which a light beam is able to be deflected onto the incident light surface of the mirror element and/or the filter element, which is developed as a mirror, and is readjustable using the supplying with current of the coil about a second axis of rotation that is aligned at an inclination to the first axis of rotation. Using the present invention, one may thus implement a mirror device by which the light beam is able to be deflected about one axis of rotation, respectively, by using two mirrors. Even though the light beam deflected by the additional mirror element is not incident in a stationary manner on the mirror element and/or filter element developed as a mirror, and therefore a comparatively large incident light surface of the mirror element and/or filter element is an advantage, because of the mounting of the coil below or above the mirror element and/or filter element, a surface reduction of the micromirror device may be implemented compared to the usual device having two adjustable mirrors. Besides that, a mechanical lever may be used to readjust the mirror element and/or filter element, whereby the mirror element and/or filter element is still reliably adjustable in spite of its comparatively large incident light surface, using a cost-effective drive.

The abovementioned advantages are also able to be effected by a corresponding production method for a micromechanical component.

Furthermore, the advantages may also be ensured by an appropriate production method for a micromirror device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a schematic cross section of a first specific embodiment of the micromechanical component.

FIGS. **2***a*-**2***d* show schematic cross sections of a second specific embodiment of the micromechanical component.

FIG. **3** shows a schematic cross section of a third specific embodiment of the micromechanical component.

FIG. **4** shows a schematic cross section of a fourth specific embodiment of the micromechanical component.

DETAILED DESCRIPTION

FIG. **1** shows a schematic cross section of a first specific embodiment patterned out of component.

The micromechanical component shown schematically in FIG. **1** has a mounting support **10**. Mounting support **10** is connected to an actuator plate **12** via at least one supply line spring (not sketched in FIG. **1**). On and/or in actuator plate **12**, a coil **14** is situated (that is only schematically reproduced). Coil **14** may be composed of a plurality of line sections, made of a metal and/or a doped semiconductor material, which is embedded in an insulating material **16**. Coil **14** is preferably made of copper. The ability to be developed, of coil **14**, that is not shown here in greater detail, is not limited to the use of copper. Coil **14** may be embedded in an oxide, for example, as the at least one insulating material. In this way, the mechanical stability of coil **14** is able to be improved. The insulating material is also able to protect coil **14** from environmental influences.

The micromechanical component reproduced here is not limited to any particular development of coil **14**, to a certain conductive material of coil **14** and/or to a certain insulating material **16**. For this reason, we shall not go further into the construction and the material composition of actuator plate **12** at this point.

The micromechanical component also has a mirror element and/or filter element **18**, which is connected via actuator plate **12** and the at least one supply line spring to mounting support **10**. Between actuator plate **12** and mirror element and/or filter element **18** a spacer **20** is situated which, at a first end **20***a* of spacer **20** contacts the inner side **24** of mirror element and/or filter element **18** that faces away from incident light surface **22** of mirror element and/or filter element **18**. By incident light surface **22** of mirror element and/or filter element **18** one may also understand a mirror side, a mirror surface, an incident light side and/or an optically active area. Inner side **24** of mirror element and/or filter element **18** is preferably aligned counter to incident light surface **22**. One may also paraphrase this to say that inner side **24** faces actuator plate **12**, while incident light surface **22** is directed away from actuator plate **12**. Inner side **24** of mirror element and/or filter element **18** may optionally be covered by an insulating material.

At the second end **20***b* of spacer **20**, the latter contacts a carrier side **26** of actuator plate **12** that faces mirror element and/or filter element **18**. Spacer **20** is preferably inclined, particularly at right angles, to a longitudinal direction/maximum extension of actuator plate **12**. Spacer **20** may be aligned, particularly in an inclined manner, more preferred at right angles, to incident light surface **22**, inner side **24** and/or carrier side **26**.

The construction of the micromechanical component that is schematically reproduced in FIG. **1** may also be paraphrased as an implementation of an electromagnetic drive in three planes **28** to **32**. A drive plane **28** includes coil **14** that is functioning as drive unit and the at least one supply line spring. At least one line is preferably guided via at least one supply line spring in such a way that coil **14** is able to be supplied with current. We shall go into an advantageous specific embodiment possibility of the at least one supply line spring in greater detail below.

Adjacent to drive plane **28**, an intermediate plane **30** is developed, having spacer **20**. Spacer **20** may have a height z, which is not limited to a certain value. As will be stated more accurately below, by a suitable establishment of the height z, an advantageous mechanical lever may be implemented for readjusting mirror element and/or filter element **18**.

On a side of intermediate plane **30** facing away from drive plane **28**, there is an optically active plane **32** having mirror element and/or filter element **18**. Using mirror element and/or filter element **18** and coil **14** in the two different planes **28** and

32, the extension of the micromechanical component in a spatial direction parallel to incident light surface **22** is able to be reduced. While usually a micromirror having a magnetically adjustable mirror plate has an additional installation space requirement for mounting the coil device that at least partially frames the mirror plate, in the specific embodiment shown here, coil **14** is able to be positioned below/above mirror element and/or filter element **18**. Because of the reduction that is able to be implemented, in this manner, of the extension of the micromechanical component along the incident light surface, its arrangement at a preferred mounting position is simplified. Besides that, using the reduction of the micromechanical component in the spatial directions directed in parallel to the incident light surface, production costs may be saved.

The specific embodiment shown in FIG. **1** has an electromagnetic drive, mirror element and/or filter element **18** being able to be set into an adjusting motion by supplying coil **14** with current and by providing a magnetic field (not reproduced) at coil **14**. In a preferred manner, mirror element and/or filter element **18** is additionally connected to mounting support **10** via at least one vibratory spring **34**, which spans at least one gap lying between mirror unit and/or filter unit **18** and mounting support **10**. Because of the additional connection of mirror element and/or filter element **18** to mounting support **10** using the at least one vibratory spring **34**, the stiffness of the overall spring system, made up of the at least one line spring and the at least one vibratory spring **34** is able to be increased. In this way, a natural frequency of a preferred vibrational motion of the mirror element and/or filter element is able to be set to a preferred value. In addition, using the at least one vibratory spring **34**, an adjusting motion of mirror element and/or filter element **18** may be specified that is partially decoupled from a drive motion of actuator plate **12** when coil **14** is supplied with current.

In one advantageous specific embodiment, supplying current to coil **14** and providing the magnetic field have the effect of a Lorenz force, using which a center of mass and/or a center point **36** is displaced along a first spatial direction **38** with respect to mounting support **10**. The lateral displacement of center of mass **36** may be aligned, for example, in parallel to carrier side **26** and/or a maximum extension of actuator plate **12**. Spacer **20** is preferably aligned perpendicular to first spatial direction **38**.

The at least one vibratory spring **34** may be developed as a torsional spring, for example. (The at least one vibratory spring **34** is not limited, however, to a design as a torsional spring). Using the design of vibratory spring **34** as a torsional spring, the readjusting motion of the mirror element and/or filter element **18** may be reliably established to be a rotational motion about an axis of rotation that is preferably aligned along at least one vibratory spring **34**. In this case, the readjusting of center of mass **36** along first spatial direction **38** has the effect of a rotational motion **40** of mirror element and/or filter element **18** of incident light surface **22** about an axis of rotation established by the at least one vibratory spring **34**, whereas carrier side **26** of actuator plate **12**, in the case of not supplying current to coil **14**, is aligned parallel to incident light surface **22** and/or inner side **24** of mirror element and/or filter element **18**. A rotational angle α, not sketched in FIG. **1**, of excursioned incident light surface **22** with respect to the initial position of incident light surface **22**, may be calculated according to equation (eq. 1):

$$\alpha = \arctan(x/z), \qquad \text{(eq. 1)},$$

where x is a lateral displacement of center of mass **36** from its initial position. (The height z may particularly be the distance between center of mass **36** and the axis of rotation. One could also give rotational angle α by using a transformation of the equation (eq. 1) to equation (eq. 2):

$$x = z^{*}\tan\alpha \qquad \text{(eq. 1)},$$

Thus, for a desired angle α of 10° and a height z of 50 μm, a lateral displacement x of less than 9 μm is sufficient. This low lateral displacement x requires only a slight deformation of the at least one supply line spring. Consequently, the mechanical stress of the at least one line, which is preferably guided via at least one supply line spring, is also small. The danger of breakup of the at least one line in response to the readjusting of mirror element and/or filter element **18** is thus negligible.

Besides, readjustment path/rotational motion **40** of mirror element and/or filter element **18** may counteract the supply line spring constant of the at least one supply line spring and the vibratory spring constant of the at least one vibratory spring **34**, the supply line spring constant of the at least one supply line spring being less than the vibratory spring constant of the at least one vibratory spring **34**. The at least one supply line spring constant may be less than one-half the vibratory spring constant, for example. The supply line spring constant may particularly be less than one-fifth of the vibratory spring constant. It is ensured by the comparatively small supply line spring constant that the readjusting of mirror element and/or filter element **18** triggers hardly any mechanical stress in the at least one supply line spring. Based on the advantageous guidance of the at least one line via the at least one supply line spring having at least a comparatively small supply line spring constant, only comparatively low mechanical stresses are exerted upon the at least one line. Consequently, the breakup of the at least one line is thus not to be feared even when there is frequent operation of the micromechanical component. And so, for the development of at least one line, materials may be used that have good conductivity, even if these have only a low rigidity. The energy consumption in the operation of the micromechanical component may be reduced by this optimization of the lines.

The advantageous ratio, quoted above, of the supply line spring constant and the vibratory spring constant is implemented, for instance, provided the at least one supply line spring is formed exclusively of at least one conductive material, which spans at least one additional gap lying between actuator plate **12** and mounting support **10** in a self-supporting manner. One may also rewrite this to say that the at least one supply line spring is developed as a line/conductor trace. The advantageous ratio of the spring constants is also ensured if the at least one supply line spring is patterned out of a first layer having a first layer thickness, the at least one vibratory spring **34** being patterned out of a second layer having a second layer thickness that is greater than the first layer thickness. As an alternative or a supplementation, the at least one supply line spring may be developed to be meander-shaped and/or spiral-shaped. Using a meander-shaped and/or a spiral-shaped development of the at least one supply line spring, the supply line spring constant may be reduced advantageously. In particular, using a meander-shaped and/or spiral-shaped development of the at least one supply line spring, the supply line spring constant is also able to be reduced if the at least one supply line spring is patterned out having a comparatively large layer thickness.

FIGS. **2***a* to **2***d* show a schematic cross section of a second specific embodiment of the micromechanical component.

The micromechanical component shown schematically in FIGS. **2***a* to **2***d* has the components already described above. In addition, in the cross sections through drive plane **28** of

FIGS. **2***b* and **2***d*, supply line springs **42** are also shown. In the specific embodiments of FIGS. **2***b* and **2***d*, supply line springs **42** are drawn into actuator plate **12**. Alternatively, supply line springs **42** are also able to contact actuator plate **12** on an outer edge.

In the specific embodiment reproduced here, coil **14** includes twelve coil lines, which run from the outer edge of actuator plate **12** to the middle of actuator plate **12**. In each case, four coil lines running from the outer edge to the middle of actuator plate **12** are interconnected to form a coil ring. The number of supply lines and/or of coil rings of the micromechanical component may, however, be selected optionally. In this way, an available Lorenz force F for the readjusting of actuator plate **12** or mirror element and/or filter element **18** is able to be varied, particularly able to be increased. (The construction of coil **14** is reproduced only schematically in FIGS. **2***b* and **2***d*).

The coil lines preferably run partially parallel and partially perpendicular to the axis of rotation **44**, established using the at least one vibratory spring **34**, of mirror element and/or filter element **18**, and projected into FIGS. **2***b* and **2***d*. A current flow through coil lines running parallel to axis of rotation **44** and magnetic field B, whose field lines are aligned inclined, preferably perpendicular to actuator plate **12** and/or to carrier side **28**, effect a Lorenz force F perpendicular to axis of rotation **44**. On the other hand, the coil lines aligned perpendicular to axis of rotation **44** effect force components which are mutually compensating.

FIGS. **2***c* and **2***d* show the micromechanical component during the supplying of current to coil **14**. Because of the provision/application of a magnetic field B, whose field lines are inclined on the first side of axis of rotation **44** in a first direction, preferably perpendicular to actuator plate **12** and/or carrier side **26**, and which run on a second side of axis of rotation **44**, that is opposite to the first side, in a second direction running counter to the first direction, it may be ensured that the individual force components of the coil lines running parallel to axis of rotation **44** add up to an advantageously large Lorenz force F. Thus, actuator plate **12**, or rather its center of mass **36**/center point may be displaced reliably by a lateral displacement x, in first spatial direction **38**, with respect to mounting support **10**. Spacer **20** may also correspondingly be shifted by a lateral displacement x, in the first spatial direction **38**, with respect to mounting support **10**. In this way, mirror element and/or filter element **18** are able to be adjusted by an angle of rotation a that was defined above.

FIG. **3** shows a schematic cross section of a third specific embodiment of the micromechanical component.

The specific embodiment reproduced schematically in FIG. **3** has a layer **52** applied onto a carrier layer **50**, which includes coil lines (not sketched), which are embedded in insulating material **16**. Layer **50**, together with spacer **20** and a frame part **54** of mounting support **10**, may be etched out of a semiconductor layer. This may be done, for example, by isotropic underetching of mirror element and/or filter element **18** that is developed as a mirror plate. The isotropic etching step carried out for this purpose may be stopped so early that residual regions of the semiconductor layer, at a distance from the mirror plate, still remain behind as carrier layer **50**. In this way, the mechanical stability of actuator plate **12** may be increased.

FIG. **4** shows a schematic cross section of a fourth specific embodiment of the micromechanical component.

In the specific embodiment reproduced schematically in FIG. **4**, actuator plate **12** is formed (exclusively) of coil **14** (not sketched) embedded in at least insulating material **16**. Actuator plate **12** is suspended in a self-supporting manner, using at least two supply line springs, in a recess of mounting support **10**. This is able to be implemented by carrying out an isotropic etching step for patterning out frame part **54** and spacer **20** of a common semiconductor layer until the semiconductor material contacting layer **52**, such as silicon, has been completely removed. Actuator plate **12**, having a comparatively small mass, may be readjusted in this case using a comparatively small force.

The specific embodiments described above of the micromechanical component may be used in a micromirror device. Such a micromirror device may advantageously be used for the optical deflection of a light beam, for instance, as a projector and/or scanner.

In one advantageous specific embodiment of the micromirror device, it additionally includes a further mirror element that is able to be adjusted about a first rotational axis, by which a light beam, especially a laser beam, is able to be deflected onto incident light surface **22** of mirror element and/or filter element **18**, the mirror element and/or filter element **18** being developed as a mirror, and is adjustable using the supplying with current of coil **14** about a second axis of rotation that is aligned at an inclination to the first axis of rotation. The second axis of rotation may particularly be aligned perpendicular to the first axis of rotation. Consequently, the micromirror device may advantageously be used in a picture projector and/or in a 2-D scanner. Such a micromirror device may particularly be used advantageously in a head-up display of a motor vehicle.

Although the light beam deflected by the mirror element that is adjustable about the first axis of rotation is not incident in a stationary manner on incident light surface **22**, and therefore a comparatively large extension of incident light surface **22** is of advantage, a volume occupied by mirror element and/or filter element **18** and coil **14**, in a direction aligned in parallel to incident light surface **22**, may be relatively small. This is able to be effected by using the advantageous accommodation of coil **14** outside of optical plane **32** together with mirror element and/or filter element **18**. In addition, using the mechanical lever implemented by spacer **20**, a comparatively large torque may be exerted for adjusting incident light surface **22** to mirror element and/or filter element **18**. Consequently, the light beam deflected onto incident light surface **22** is able to be deflected reliably by an angle α about the second axis of rotation, in spite of the comparatively large extension of incident light surface **22**.

The micromechanical components explained above are able to be produced via a production method in which an actuator plate having a coil situated on or in the actuator plate is connected to a mounting support via at least one supply line spring. Thereby a mirror element and/or filter element is connected to the mounting support via the actuator plate and the at least one supply line spring. In addition, the mirror element and/or filter element is connected to the actuator plate via a spacer, which at a first end of the spacer contacts the inner side of the mirror element and/or filter element directed away from an incident light surface of the mirror element and/or filter element, and at a second end of the spacer, contacts a carrier side of the actuator plate that is aligned towards the mirror element and/or filter element. The connecting of the mirror element and/or filter element to the actuator plate via the spacer may take place, for example, by an isotropic underetching of a semiconductor layer on which the mirror unit and/or filter unit has been applied at least as a part of an etching mask.

In a preferred manner, the mirror element and/or the filter element is additionally connected to the mounting support via at least one vibratory spring, which spans at least one gap lying between the mirror element and/or the filter element and the mounting support. The at least one vibratory spring is preferably developed as a lineless spring, while at least one line is guided via the at least one supply line spring for supplying current to the coil.

In one advantageous refinement, the production method may also be used to form a micromirror device, the micromechanical component produced using the method steps described above being developed, adjustable about a first axis of rotation, to have a mirror element and/or filter element as mirror and using the supplying of current to the coil. In addition, a mirror element may be developed that is adjustable about a second axis of rotation that is aligned inclined to the first axis of rotation, using which a light beam is deflected onto the incident light surface of the mirror element and/or filter element during operation of the micromirror device. Consequently, the production method described is particularly suitable for producing a projector or a scanner.

It is hereby pointed out that the executability of the production method described here is not limited to the formation of the specific embodiments, described above, of the micromechanical component. The specific embodiments of the micromechanical component described above may also be produced using a different production method.

What is claimed is:

1. A micromechanical component, comprising:
- a mounting support;
- at least one supply line spring;
- an actuator plate including a coil situated at least one of on and in the actuator plate, the actuator plate being connected to the mounting support via the at least one supply line spring;
- at least one of a mirror element and a filter element connected to the mounting support via the actuator plate and the at least one supply line spring; and
- a spacer including:
  - a first end contacting an inner side of the at least one of the mirror element and the filter element facing away from an incident light surface of the at least one of the mirror element and the filter element, and
  - a second end contacting a carrier side of the actuator plate aligned towards the at least one of the mirror element and the filter element.

2. The micromechanical component as recited in claim **1**, wherein:
- the carrier side of the actuator plate is aligned in parallel to at least one of the incident light surface and the inner side of the at least one of the mirror element and the filter element, at least while no current is supplied to the coil.

3. The micromechanical component as recited in claim **1**, further comprising:
- at least one line guided via the at least one supply line spring in such a way that the coil is able to be supplied with a current.

4. The micromechanical component as recited in claim **1**, wherein the at least one supply line spring is formed exclusively of at least one conductive material that spans at least one gap, lying between the actuator plate and the mounting support, in a self-supporting manner.

5. The micromechanical component as recited in claim **1**, wherein the at least one supply line spring is developed to be at least one of meander-shaped and spiral-shaped.

6. The micromechanical component as recited in claim **4**, further comprising:
- at least one vibratory spring, wherein the at least one of the mirror element and the filter element is additionally connected to the mounting support via the at least one vibratory spring, the at least one vibratory spring spanning at least one additional gap lying between the at least one of the mirror element and the filter element and the mounting support.

7. The micromechanical component as recited in claim **6**, wherein the at least one vibratory spring includes a torsion spring.

8. The micromechanical component as recited in claim **6**, wherein:
- the at least one of the mirror element and the filter element is able to be set into an adjusting motion by supplying current to the coil and providing a magnetic field at the coil,
- the magnetic field is counteracted by a supply line spring constant of the at least one supply line spring and a vibratory spring constant of the at least one vibratory spring, and
- the supply line spring constant of the at least one supply line spring is less than the vibratory spring constant of the at least one vibratory spring.

9. The micromechanical component as recited in claim **6**, wherein:
- the at least one supply line spring is patterned out of a first layer having a first layer thickness, and
- the at least one vibratory spring is patterned out of a second layer having a second layer thickness that is greater than the first layer thickness.

10. The micromechanical component as recited in claim **1**, wherein:
- the actuator plate is formed from the coil embedded in at least one insulating material, and
- the actuator plate is suspended in a self-supporting manner using at least two supply line springs in a recess of the mounting support.

11. A micromirror device, comprising:
- a micromechanical component that includes:
  - a mounting support;
  - at least one supply line spring;
  - an actuator plate including a coil situated at least one of on and in the actuator plate, the actuator plate being connected to the mounting support via the at least one supply line spring;
  - at least one of a mirror element and a filter element connected to the mounting support via the actuator plate and the at least one supply line spring; and
  - a spacer including:
    - a first end contacting an inner side of the at least one of the mirror element and the filter element facing away from an incident light surface of the at least one of the mirror element and the filter element, and
    - a second end contacting a carrier side of the actuator plate aligned towards the at least one of the mirror element and the filter element.

12. The micromirror device as recited in claim **11**, further comprising:
- a further mirror element that is able to be adjusted about a first axis of rotation, and by which a light beam is able to be deflected onto the incident light surface of the at least one of the mirror element and the filter element, wherein:
  - the at least one of the mirror element and the filter element is developed as a mirror, and
  - the further mirror is adjustable, using a supplying with a current of the coil, about a second axis of rotation that is aligned at an inclination to the first axis of rotation.

13. A method for producing a micromechanical component, comprising:

connecting an actuator plate including a coil situated at least one of on and in the actuator plate to a mounting support via at least one supply line spring;

connecting at least one of a mirror element and a filter element via the actuator plate and the at least one supply line spring to the mounting support; and

connecting the at least one of the mirror element and the filter element to the actuator plate via a spacer, wherein:

a first end of the spacer contacts an inner side of the at least one of the mirror element and the filter element facing away from an incident light surface of the at least one of the mirror element and the filter element, and

a second end of the spacer contacts a carrier side of the actuator plate aligned towards the at least one of the mirror element and the filter element.

14. The method as recited in claim 13, further comprising:

additionally connecting the at least one of the mirror element and the filter element to the mounting support via at least one vibratory spring that spans at least one gap lying between the at least one of the mirror element and the filter element and the mounting support.

15. A method for producing a micromirror device, comprising:

producing a micromechanical component according to a method comprising:

connecting an actuator plate including a coil situated at least one of on and in the actuator plate to a mounting support via at least one supply line spring;

connecting at least one of a mirror element and a filter element via the actuator plate and the at least one supply line spring to the mounting support; and

connecting the at least one of the mirror element and the filter element to the actuator plate via a spacer, wherein:

a first end of the spacer contacts an inner side of the at least one of the mirror element and the filter element facing away from an incident light surface of the at least one of the mirror element and the filter element, and

a second end of the spacer contacts a carrier side of the actuator plate aligned towards the at least one of the mirror element and the filter element;

developing the at least one of the mirror element and the filter element as a mirror and adjustably about a first axis of rotation using a supplying of a current to the coil; and

developing an additional mirror element that is adjustable about a second axis of rotation that is inclined to the first axis of rotation, the additional mirror element capable of deflecting a light beam onto the incident light surface of the at least one of the mirror element and the filter element during an operation of the micromirror device.

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